Testing Instantly Available PC

Jerzy Kolinski
Oct 5, 2000

Introduction

This document describes testing procedures for the systems implementing Instantly Available PC technology. The test matrix provides high-level test methodology overview and does not address in detail test procedures. It is assumed that the reader does have basic understanding of the Instantly Available PC (IAPC) technology. For the further description of the technology the reader is referred to the IAPC web page at http://developer.intel.com/technology/iapc/index.htm.

Overview of Instantly Available PC testing procedures

The summary of IAPC testing procedures is given in Table 1. The recommended testing procedure specifies three different sets of tests. Tests for the motherboard, tests for the peripherals and extended system stability tests. The following paragraphs describe in more details testing procedures summarized in Table 1.

The VC820 is recommended to use as the reference IAPC motherboard at this time. The list of tested peripherals is available on the IAPC home page in the industry involvement section.

Motherboard measurements/tests

The series of motherboard tests ensure that the motherboard implements basic functions that allow the system to properly enter and resume from S1, S3 and S4 sleep states. No external peripherals are needed for the motherboard tests if the motherboard implements integrated graphics solution. (If graphics card is used it is important to use the graphics card that has been "qualified" using the reference IAPC motherboard).

The first test to run is the BIOS test. The test ensures that the BIOS is ACPI compliant. The IAPC system requires ACPI BIOS. The WHQL HCT tests are used for compliance testing.

In the next test the system power is measured to ensure that the AC power drawn by the system is less than 15 Watts (as required by Energy Star 2000 specification). The power drawn by typical system implementing suspend to RAM should be less than 5 Watts.

Resume time is measured from the time when the power button is pressed to the time when the system screen is painted. It is a manual test. The stopwatch can be used for measuring the delay. It is recommended that the resume time is less than 10 sec. The resume time depends on the system BIOS, OS, device drivers and the hard drive spin-up time.

The tests to validate dual mode power delivery are described next. Dual mode circuits need to be checked to ensure that the memory, PCI and USB voltages remain within regulation through the suspend/resume transitions. This test is also a manual test. The Vaux voltage can be measured with volt meter while in S0 or S3 state. The oscilloscope should be used to validate that the voltage during the transition process is in regulation. The PCI Fox Fire II card is used in this test to provide additional load on the PCI Vaux. It is recommended to set every Fox Fire card in the system to maximum load (4 cards set to 375 mA) in S0 state and next measure and verify that Vaux signal is within regulation.
The measurement should be repeated in S3 state when typically one card is set to 375 mA and the other cards are set to 20 mA. If power supply supports more than 720 mA of standby current additional load can be added using Fox Fire cards in S3 state.

The final test, in the motherboard measurement section, checks Real Time Clock (RTC) wake capabilities. The suspender program is recommended to test the system. The program puts the system to sleep and next wakes the system after specified time.

Peripheral tests

The next series of tests are peripheral tests. Peripheral tests are run to ensure that the system works correctly with PCI addin cards, USB devices, IDE/ATAPI devices and serial/parallel peripherals.

Intel has developed PCI D3 tests to ensure proper PCI addin card operation after waking up from S3 state. (Please note that the system removes power from PCI bus in S3 state.) The PCI D3 tests are designed to examine graphics, audio, modem and LAN PCI cards operation.

During modem and LAN tests PCI D3 software checks PCI wakeup capabilities to ensure that the system and addin cards support PCI Vaux.

The test for the modem wakeup is performed using two systems: client and the server. The systems are connected together using telephone line simulator. The server generates the phone call to wake up the client system. After wakeup the series of tests are run to ensure proper system functionality.

Similarly the LAN tests to validate network wakeup capabilities are run in server/client configuration. A hub should be used to connect two systems together.

For the systems supporting CNR (Communication Network Riser) the same tests as for the PCI cards need to be run to ensure correct functionality of the device. If the card for example implements modem or LAN functionality the same PCI D3 test can be run to test the CNR card.

The next sets of peripherals are USB devices. The USB test ensures that USB device drivers are written properly and work well after suspend/resume cycles. To perform the test connect the USB peripheral or the set of the peripherals to the reference system and enter sleep mode. Next wakeup the machine and check the functionality of the device.

It is important to validate that the system functions correctly when it is idle (at Windows screen and no applications are running) and also when the applications and drivers associated with the USB devices are running. In the case when the system is running it may be acceptable to reject the sleep request until the job has been completed. (For example a USB printer, which is in the middle of printing a document may reject the sleep request. The printer could delay sleep request until the job is finished and than let the system enter the sleep.)

The tests of the hard drives and the CD/DVD devices are recommended due to earlier issues seen with these devices. It is recommended to make sure that the devices are set to run in performance mode (for example DMA or UDMA mode) and next to ensure that the HDs and CD devices operate in the same mode after suspend/resume. To run the test, set the HDs and CDROMs to run in DMA or UDMA mode, next enter the sleep mode. After resuming ensure that the devices are set to the same mode and that they are operating correctly. It is also recommended to test multiple hard drive configurations such as two hard drives on the primary IDE channel or two hard drives on two different IDE channels.

Custom cards are the cards that do not fit the classes of devices specified in the previous sections. For example it can be a TV tuner card, hardware MPEG decoder or an I/O controller device. The manual tests need to be run to ensure the proper functionality of the system with these devices installed and also with them active during suspend/resume.

The last tests in this section cover serial/parallel port devices and PS/2 port. Use the same procedure as for USB devices to ensure the correct functionality after system resumes from sleep state. Examples of serial/parallel devices include printers, scanners and external storage devices. PS/2 devices include keyboards and mice. Some classes of devices such as external modems have capability of waking up the system. Therefore wake on an event should be tested to ensure that the driver and BIOS saves and restores registers properly.

System Stability Tests

The system stability tests ensure that the system is stable and functions properly over the extended period of time. These are confidence tests to determine the stability of the system. It is recommended that the *Suspender* application is run for 1000-2000 cycles in the desired configuration to test for memory leaks in the drivers and applications. (1000 cycles is equivalent to suspending/resuming the system 5 times a day for 6 month without rebooting.)

The *Suspender* application tests the operation of the system using Real Time Clock interface. It is also recommended to test the system using power button. A circuit can be developed to replace power button to automate the test.

Finally, it is recommended to use Waker/Dozer to test wakeup capabilities of PCI peripherals. The Waker/Dozer application uses server/client setup to generate wakeup event through either modem or LAN. The application can be set to run multiple times. The Waker/Dozer application is available in the Microsoft HCT suite.

The overview of the tests is given in the Table 1.

Instantly Available PC test matrix

IAPC subsystem	Test tool	Key things tested/ Comments
Motherboard measurements/ tests		
BIOS	WHQL/IPCO	ACPI specification compliance, testing for proper ACPI tables and control methods
Power measurements while in sleep state	Manual/power meter	Less than 15Watts (Energy Star 2000), ~5 Watts is recommended
Resume time measurements	Manual/stop watch	10 sec or less
Dual mode power delivery circuits: - Memory VCC - PCI Vaux - USB VCC measurements	Manual/ Volt meter PCI Fox Fire II card	3.3V PCI Vaux, USB 5V and memory voltages within regulation while in sleep and during wakeup
RTC wake	Suspender, PCI D3 tests	Proper wakeup after scheduled event.
Peripherals tests		
Graphics/ Audio	WHQL/PCID3 tests Video and Audio tests	Graphics/Audio/system functionality after wakeup
Modem/LAN/CNR	WHQL/PCID3 tests Modem and LAN tests	System functionality, PCI wakeup, Vaux connections
USB device	Manual	System functionality, USB wakeup, Vaux connections
HD/CDROM/DVD Multiple hard drive configuration	Manual	System functionality, ensure that device is in the same DMA/PIO mode and that timing is the same. Also ensure that multiple hardware configurations are working properly.
Custom cards (example: TV tuner, DVD decoder)	Manual	System/device functionality after sleep/resume.
Parallel/Serial port devices	Manual	System/device functionality after wakeup. External modem wakeup connected to serial COM port.
PS/2 Mouse/ Keyboard	Manual	System/device functionality after wakeup.
Extended stability tests: (system confidence tests)		
- 1000-2000 suspend/resume cycles	Suspender	System stability using RTC wake
- 150 power button cycles	Power switch simulator	System stability using power button
- Modem/LAN multiple wakeups	Waker/Dozer	System stability using PCI wake mechanism

Notes:

- Tests should be repeated for all supported sleep states S1, S3, S4 (PCI-D3 tests are designed specifically to test the PCI bus when power is removed)
- Systems should be configured including all the peripherals.
- BIOS needs to set wake events as default to pass WHQL
- Hard Drives and CD-ROMs should be set to DMA mode
- Programs such as Dumppo from Microsoft can change power state to S1, S2 and S3.

Table 1: Instantly Available PC test matrix

Summary

Testing of the IAPC systems is a critical step to ensure that the Instantly Available PC technology works properly. The IAPC requires the whole system to be designed with power management in mind. Therefore it requires ACPI enabled hardware, operating system, BIOS, drivers and peripherals to support the IAPC capabilities.

The growing number of users expects these capabilities. IAPC technology becomes requirement of the PC Design Guide 2001, WHQL and Energy Star 2000.

To find out more about the technology and compliant motherboards, peripherals and drivers please consult the IAPC web page. This list can be found at http://developer.intel.com/technology/iapc/involve.htm .

The tools described in this white paper are available from Intel and Microsoft. They can be found in Microsoft HCT test suite and in the Intel's IPCO test suite.